THE EUROPEAN CORN BORER

A MENACE TO THE COUNTRY'S CORN CROP

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THE EUROPEAN CORN BORER probably is the most injurious plant pest that has yet been introduced into this country. It is now known to be present in an area of about 320 square miles near Boston, Mass. Unless repressed and restricted it may spread throughout the country and cause serious and widespread losses to the corn crop.

The larvæ, or borers, tunnel through all parts of the corn plant and destroy or severely injure the ears and stalks. The pest also attacks celery, Swiss chard, beans, beets, spinach, oats, potatoes, tomatoes, turnips, dahlias, chrysanthemums, gladiolus, geraniums, timothy, and certain weeds and grasses.

There are two generations each year, so that multiplication and spread are rapid, especially as very few of the borers are destroyed by natural enemies. The winter is passed in the larva or borer stage within infested plants.

To suppress this pest burn or otherwise destroy during the fall, winter, or spring all cornstalks, corn stubble, crop remnants, and stalks of garden plants, weeds, or wild grasses within the infested areas likely to harbor the overwintering borers. Work of this kind is now being conducted by the Federal, State, and local authorities, and the hearty cooperation of all property owners, tenants, or other interested persons is earnestly solicited. *This work must be done very thoroughly.* The borers in a few overlooked plants may increase by the end of the season to as many as were present before the clean-up.

To prevent the spread of the insect, quarantine measures, both Federal and State, must be strictly enforced to prevent shipment of infested plants or plant products out of the area now infested.

Imprisonment for five years and a fine of $5,000 are the penalties provided by law for the intentional transportation of this pest.

THE EUROPEAN CORN BORER[1]: A MENACE TO THE COUNTRY'S CORN CROP.

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SERIOUS NATURE OF THE INSECT.

THE FUTURE of the Country's corn crop is seriously threatened by the presence of the European corn borer (fig. 1) in eastern Massachusetts. This insect has long been recognized in Europe and Asia as one of the worst pests attacking corn, millet, hops, and hemp. In France and Hungary, according to European entomologists, from one-fourth to one-half of these crops is frequently destroyed by it. Judging from the unenviable reputation which it has earned in foreign lands and from its depredations during the past two years in the cornfields of eastern Massachusetts, it is evident that the European corn borer may prove to be the most injurious plant pest that has yet been brought into this country from abroad.

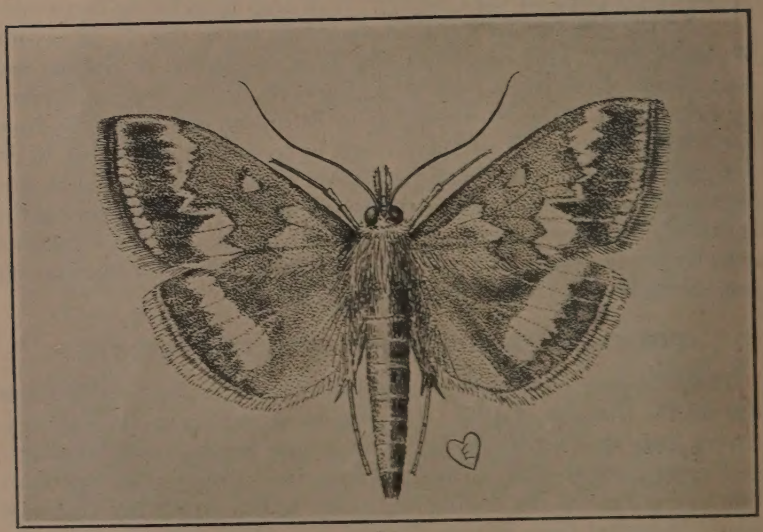
DISCOVERY AND DISTRIBUTION IN THIS COUNTRY.

The European corn borer was first discovered in the United States during the summer of 1917. Investigations conducted since its discovery have shown that the insect must have become established several years prior to 1917. The exact date and manner of its introduction are unknown, but indications point to the possibility that raw hemp, imported from Europe for use in cordage factories along the Mystic river near Boston, Mass., may have been the medium through which this destructive pest gained entrance to the country.

[1] *Pyrausta nubilalis* Hübner; order Lepidoptera, family Pyralidae, subfamily Pyraustinae.

It is now known to be present in 34 towns in Massachusetts, comprising an area of about 320 square miles, located immediately west,

a.



b.

FIG. 1.—The European corn borer: *a*, Female moth; *b*, male moth.

north, and northeast of Boston (fig. 2). Additional surveys during the past season in the adjoining territory of Massachusetts, New Hampshire, Maine, Rhode Island, and Connecticut failed to disclose

the presence of the insect in New England outside of the area outlined.

During January, 1919, however, the pest was reported and identified in the larva stage from cornstalks in the vicinity of Schenectady, N. Y., where it is said to infest an area of approximately 400 square miles; and portions of the counties of Montgomery, Schenec-

FIG. 2.—Map showing distribution of the European corn borer in Massachusetts.

tady, Albany, and Saratoga. It is supposed that the borer was introduced into this region in bales of broom corn imported from Austria.

PLANTS ATTACKED BY THE INSECT IN MASSACHUSETTS.

At the present time corn is the principal crop attacked by the European corn borer in Massachusetts. This includes sweet corn, field corn, and fodder corn. In areas where corn is not grown, or in the vicinity of badly infested corn plants, the borers commonly attack a great variety of other plants including celery, Swiss chard, green

or string beans, beets, spinach, oats, potatoes, tomatoes, turnips, dahlias, chrysanthemums, gladiolus, geraniums, timothy, and several

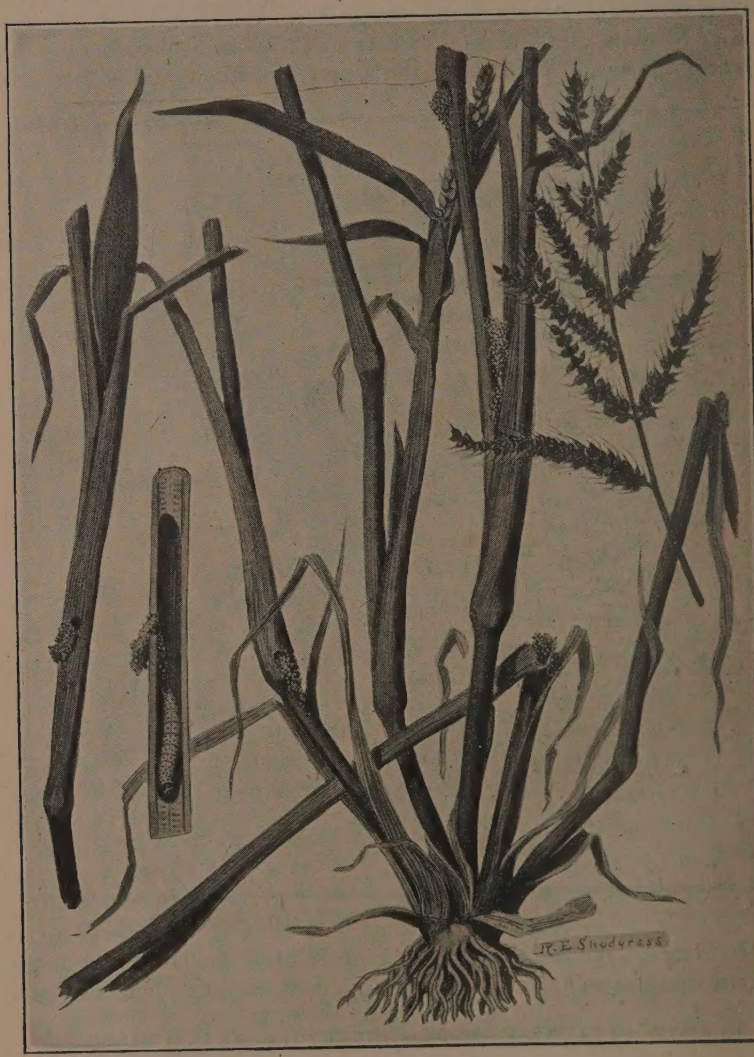


FIG. 3.—Barnyard grass infested by the European corn borer.

different species of weeds and wild grasses (fig. 3), including barnyard grass [1], redroot pigweed [2], dock [3], ragweed [4], lamb's-quarters [5],

[1] *Echinochloa crus-galli* Beauv.
[2] *Amaranthus retroflexus* L.
[3] *Rumex crispus* L. and *R. obtusifolia* L.
[4] *Ambrosia* spp.
[5] *Chenopodium album* L.

foxtail grass [1], lady's thumb [2], burdock [3], horseweed [4], beggars' ticks [5], purslane [6], crab grass [7], scouring rush [8], panic grass [9], goldenrod [10],

FIG. 4.—The European corn borer: Corn plant showing feeding punctures caused by larvæ on leaf blade.

thistle [11], apple of Peru [12], and wild hemp [13]. Further investigations will probably show that other plants are infested.

[1] *Setaria glauca* Beauv.
[2] *Polygonum persicaria* L.
[3] *Arctium minus* L.
[4] *Erigeron canadensis* L.
[5] *Bidens frondosa* L.
[6] *Portulaca oleracea* L.
[7] *Digitaria sanguinalis* Scop.
[8] *Equisetum* spp.
[9] *Panicum dichotomiflorum* Michx.
[10] *Solidago* sp.
[11] *Cirsium* spp.
[12] *Nicandra physaloides* Gtn.
[13] *Cannabis sativa* L.

CHARACTER OF INJURY TO CORN.

The larvæ or borers of the European corn borer tunnel through all parts of the corn plant except the fibrous roots. They even feed

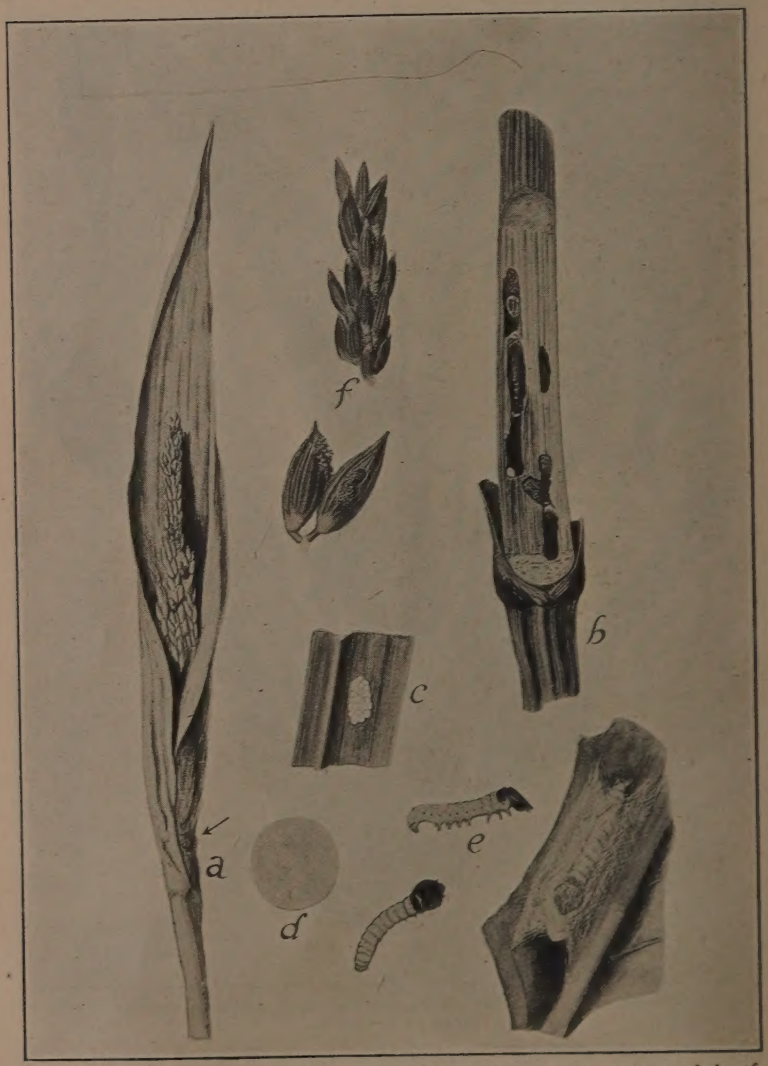


FIG. 5.—The European corn borer: *a*, Immature tassel showing entrance hole of young larva; *b*, longitudinal section of dried cornstalk, showing pupa in its cocoon within the burrow; *c*, cluster of eggs; *d*, the egg; *e*, newly hatched larvæ; *f*, unopened tassel bud showing work of young larvæ.

within the midrib and upon the surface of the leaf blades (fig. 4). They cause their most serious damage, however, by their work in the stalks and ears, which they partially or totally destroy. Generally,

they enter the stalk at its upper end near the base of the tassel (fig. 5, *a*) and at first tunnel upward. This damage so weakens the tassel

FIG. 6.—Broken tassel. Injury caused by work of larvæ of European corn borer in flower stem.

stalk that it breaks over before the tassel matures (fig. 6), resulting in loss of pollen and the lack of normal grain formation on the ears. These broken tassels, with extrusions of sawdust-like material at the

breaks, are the most conspicuous signs of infestation in a field. Field counts in badly infested areas have shown as many as 60 per cent of the tassels broken over in this manner.

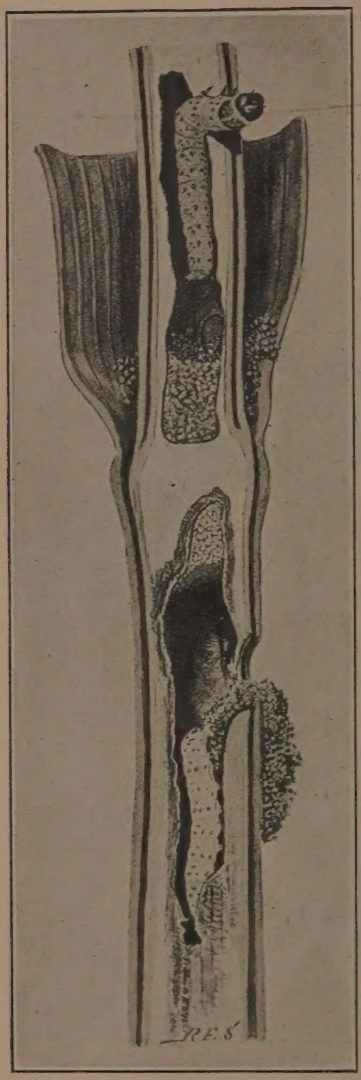


FIG. 7.—Longitudinal section of stalk showing tunnels of larvæ of the European corn borer therein.

After destroying the tassel the borers tunnel downward through the stalk (fig. 7), gradually increasing the size of their tunnels as they develop. Instead of entering the stalk near the tassel many of the borers enter between the leaf sheath and stalk at a point lower down and tunnel upward or downward (fig. 8), according to their individual preferences. Small holes in the stalk with sawdust-like extrusions indicate where the borer is at work. When several or many borers are present within the same stalk, as is frequently the case, the stalk becomes reduced to a mere shell, filled with fragments of the frass or castings of the borers. This injury cuts off the supply of nutriment to the developing ear and greatly weakens the stalk, which eventually breaks over.

Some of the partly grown borers leave the stalk and enter the ears through the husk (fig. 9) and also through the stem and cob (fig. 10). Here they feed upon the immature grain and tunnel through all parts of the cob. During July and August many of the moths deposit their eggs directly upon the newly developed ears of late corn.

The resulting borers feed at first upon the silk, and then enter the ears directly, where they feed voraciously upon the grain and cob. As many as 15 full-grown borers, each about an inch long, have been found feeding upon and within a single ear of corn (figs. 11 and 12). This extensive injury to the ear results in its complete destruction.

Some idea of the extent of injury to corn plants may be gained from the following: Seventy-five plants, comprising 17 hills, were selected at random from a badly infested cornfield at West Medford,

FIG. 8.—Cornstalks; external view, showing extruded frass and entrance to burrow of larva of the European corn borer.

Mass., and all the borers found therein were carefully removed and counted. Forty-six borers, on an average, were found in each plant, and one of the plants contained 117 borers. One hill consisting of 4

plants contained 311 borers (fig. 13). At the average rate of 46 borers per plant, an acre of corn would contain over a million borers.

The injury to stalks and ears is still further increased by a soft rot which often follows the work of the borers and reduces the interior

FIG. 9.—External view of ear, showing extruded frass and numerous punctures caused by larvæ of the European corn borer.

of infested plants to a decaying, putrid mass with a distinctly obnoxious odor.

CHARACTER OF INJURY TO PLANTS OTHER THAN CORN.

The stalks of celery, potatoes, tomatoes, oats, dahlias, chrysanthemums, gladiolus, and geraniums, as well as the leafstems and leaves

of Swiss chard, beets, and spinach, are entered and damaged by the borers in a manner similar to that described for corn. Occasionally the borers are found tunneling within the pods, immature seeds, and vines of beans. The green seed heads of timothy and the leaf stems of turnips are sometimes fed upon externally by the borers. In addition to the actual loss caused by the work of the borers in these crops there is also the possibility that some of their products when shipped to market may contain the insect and thus serve as carriers of the pest to new localities.

FIG. 10.—Longitudinal section of ear of sweet corn damaged by European corn borer, showing entrance of larva, the stem, and cob.

Injury to the weeds and wild grasses (see fig. 3) mentioned as food plants of the European corn borer is of the same general character as that to corn. Although such injury is not of itself commercially important, the presence of these weeds and grasses affords abundant opportunity for the multiplication and spread of the pest in areas where corn is not grown, or in fields where the borers are so numerous that they are compelled to feed upon these other plants in order to complete their growth. There is also a possibility that some of these plants, when used for packing material or as bedding, may contain the borers and thus be a medium for transporting the pest to new localities.

SEASONAL HISTORY AND HABITS.

The European corn borer passes the winter as a full-grown, or nearly full-grown, larva or borer, within the tunnel made in its host

plant during the previous summer and fall. The presence of these overwintering borers may be detected readily by small holes on the surface of infested plants, with massess of the frass, or castings of the borers, extruding therefrom. This frass is generally white or light brown in color and closely resembles sawdust. Upon cutting open these plants the borers will be found within.

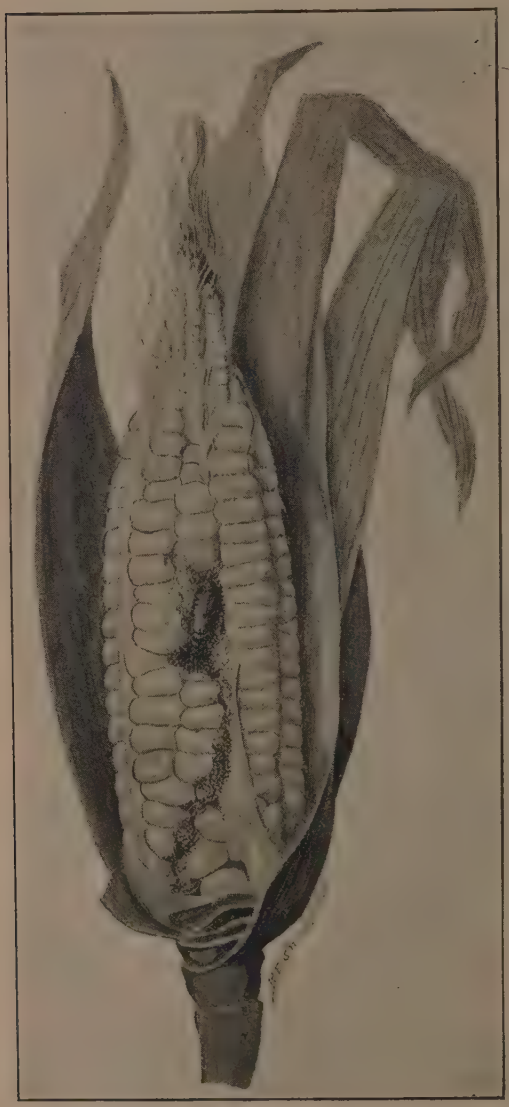


FIG. 11.—Ear of field corn, showing injury due to work of larva of the European corn borer, which has now become a pupa.

At this time the borer (fig. 14) is about an inch long and one-eighth of an inch thick. The head is dark brown or black. The upper surface of the body varies from light brown or dark brown to pink. Each segment, or division, bears a row of small dark-brown spots, while several narrow dark-brown or pink lines extend lengthwise of the body. The underside of the body is flesh colored and devoid of markings.

As soon as warm weather begins, in April or May, the borers resume their feeding operations and become full grown about the middle of May.

After reaching full growth the borer cuts a small circular opening from its tunnel to the surface of the plant in order to provide an exit for the future moth.

It then closes this exit hole with a thin partition of silk and retreats into its tunnel to a point near the last feeding place, where it spins a thin cocoon of silk. Inside this cocoon the borer changes into the pupa or resting stage (fig. 5, *b*).

FIG. 12.—Ear of sweet corn with husk partially removed; larvæ of the European corn borer at work within.

The pupa (fig. 15) is cone shaped, light brown or dark brown, and from one-half to three-fourths of an inch in length. During this stage the insect does not feed and can not move from one place to another. After remaining in this condition for about two weeks,

or until the first week of June, the skin of the pupa splits and the fully developed adult, or moth (fig. 16), emerges therefrom.

The female moth (fig. 1, *a*) has a robust body, with a wing expanse of a little more than an inch, and is pale yellow. The outer third of the forewing is crossed by two narrow lines darker than the rest of the wing, while the hindwings are lighter yellow. The male moth (fig. 1, *b*) has a long slender body, is slightly smaller in wing expanse, and is reddish brown, being much darker than the female. The forewing is crossed by two narrow dark-brown lines, inclosing a pale yellow streak, and there are two small yellow spots near its center. The hindwings are grayish and crossed by a broad band of pale yellow.

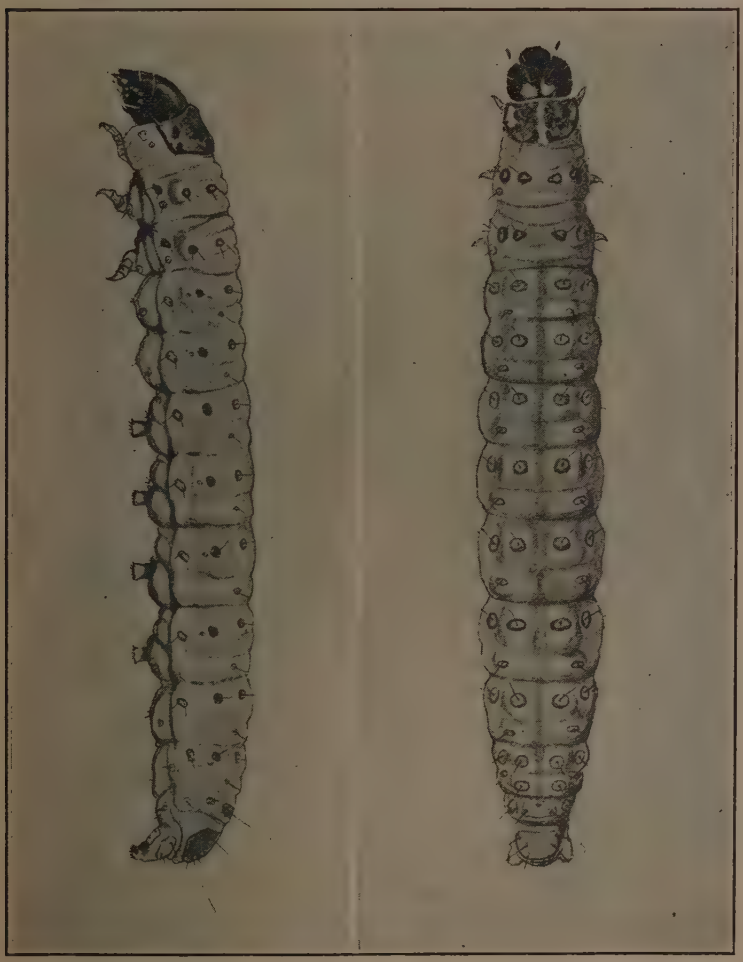
FIG. 13.—Bottle containing European corn borers. Collected from one hill containing four stalks of corn; 311 borers.

In the moth stage the insect is not injurious and does not partake of any solid food.

Soon after emergence the moths mate and begin to deposit eggs. They remain quiet during the day, hiding in patches of grassland or underneath the leaves of plants. At night they fly from plant to plant, depositing their eggs in flat, irregular-shaped masses (fig. 5, *c*) of from 5 to 50 eggs each, on the underside of the leaf. Each egg overlaps the adjoining eggs in the manner of shingles. The moths of this brood average about 350 eggs each, and one moth under observation deposited 727 eggs.

The egg (fig. 5, *d*) is nearly flat and about one twenty-fifth of an inch in diameter. It is white when first deposited but later changes to yellowish, becoming darker just before the young larva, or borer, hatches therefrom.

The eggs hatch in from 5 to 9 days, the length of the egg stage varying with the temperature. The newly hatched borer (fig. 5, *e*) is about one-fifth of an inch long, with a black head and a white body



a. *b*.

FIG. 14.—Full-grown larva of the European corn borer: *a*, Lateral view; *b*, dorsal view.

covered with black or brown spots. It feeds for a few days upon the surface of the leaf, near its place of hatching, and upon the unopened buds of the tassel (fig. 5, *f*), but soon enters the plant and completes its development therein.

During its growth the borer molts, or changes its skin, five or six times, gradually becoming darker and growing until it is of the same appearance and size as the overwintering borer previously described. By the middle of July, or about 44 days after hatching from the

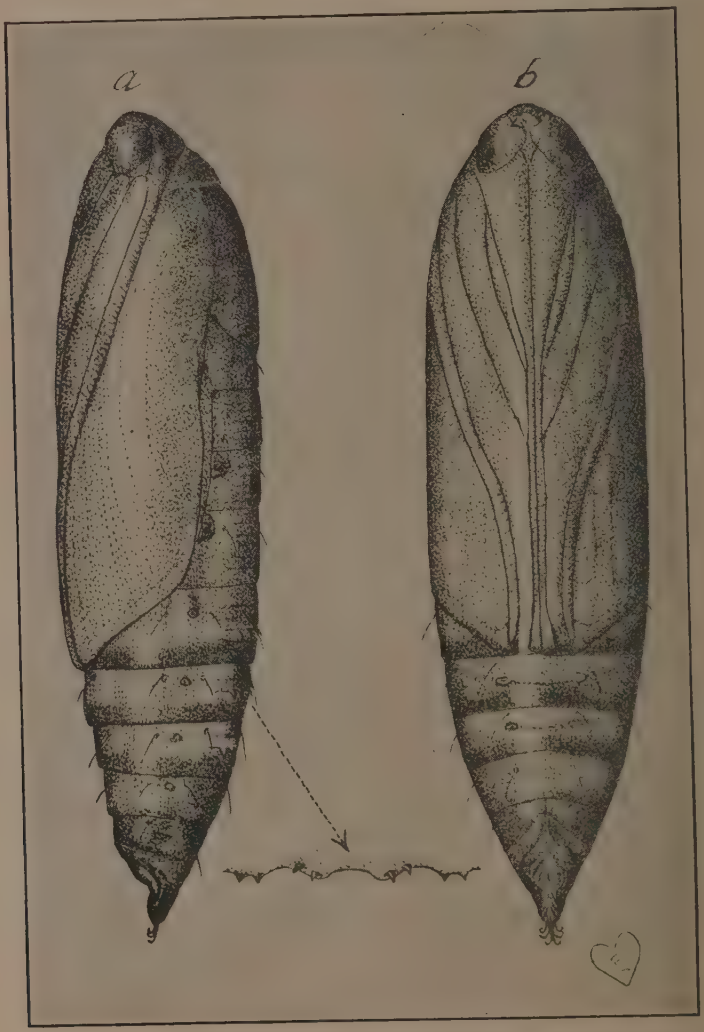


FIG. 15.—Pupa of European corn borer: *a*, Lateral view; *b*, ventral view.

egg, the borer is full grown and changes to the pupa, or resting stage, inside its tunnel in the food plant. About 9 days later, or during the last week of July, the moths of the next generation emerge from these pupæ and deposit their eggs as described for the first brood

of moths in June. Many of these eggs are deposited directly upon the newly developed ears of late corn. On an average, about 550 eggs are deposited by each female moth of this generation, and individual females sometimes deposit as many as 900 eggs each.

These eggs hatch in from 4 to 8 days, depending upon the temperature. The resulting borers attack the plant in a manner similar to that described for the first generation.

At this time the injury to the ears of late corn is very great, due to the fact that many of the borers make their way directly into the ears after hatching from the egg. The borers continue to feed until cold weather stops their activities in November or early December. They remain as full-grown or nearly full-grown borers within their tunnels in the food plant throughout the winter and resume feeding in the spring.

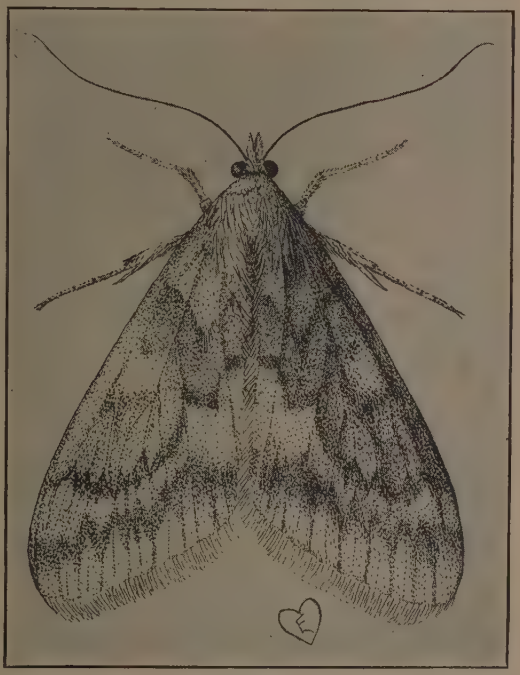


FIG. 16.—Newly emerged female moth of the European corn borer.

It will be noted that there are two generations of the European corn borer each year and that the moths of the first generation deposit about 550 eggs each, while the moths of the second generation deposit about 350 eggs. As about half of the resulting moths are females, it is evident that the pest is able to multiply very rapidly.

PECULIAR FEEDING HABITS OF THE INSECT.

The feeding habits of some individuals of the European corn borer are very peculiar, and this must be taken into account when measures for the control or eradication of the insect are under consideration.

During late July or early August the moths of the second brood frequently deposit their eggs upon the stubble of the early corn.

The young borers feed at first upon the exposed pith at the cut end of the stubble, and then complete their growth while tunneling through the stubble and taproot of the same plant or plants in the vicinity. The borers are commonly found in the corn stubble and taproot during the fall, winter, and spring. This necessitates the careful clean-up and destruction of all such material.

The moths also deposit their eggs occasionally upon the dead and dried cornstalks of the previous year, or from an early-season crop. The resulting borers complete their development by feeding upon and within this material, in a manner similar to that when feeding on living corn plants.

The borers continue to feed within the cobs of corn stored on the cob until their development is completed, although the cobs and grain become exceedingly dry and hard. They are able to pass the winter successfully in these cobs and resume feeding in the spring. In one instance, during April, 1918, living larvæ were found feeding within the cobs of sweet-corn ears that had been stored for seed during the preceding August.

The overwintering borers do not always complete their development the following spring, but may continue to feed for long periods thereafter. A quantity of cornstalks of 1917 containing the overwintering borers were collected during April, 1918, and placed in tight emergence cages. Several hundred adults emerged from these cages during May and June, 1918, but upon dissecting these cornstalks in September and October, 1918, many living borers, still active and feeding, were found to be present. These individuals were over a year old, and indicate that borers may live for a long period and exist under very adverse circumstances.

Nearly full-grown borers, confined in individual glass vial cages without food or water, lived, on an average, for about one month.

Although most individuals, after reaching the second instar, pass the remainder of their larval and pupal periods within the plants, occasional borers, in all stages of their development from newly hatched to full-grown larvæ, may be found feeding upon the surface of the plants, especially of corn. They are very often found feeding upon the outer surface of the ears, upon the green tassel, and near the junction of the leaf sheath and the stalk. Occasional larvæ have been observed crawling along the ground, apparently in search of food. Pupæ have frequently been found between the buds of the tassel, in the silk of the ear, at the intersection of leaf blades, between the folds of leaf blades, at the junction of the leaf sheath and the stalk, under clods of soil near infested plants, and underneath rubbish in the infested fields. Pupæ have also been found in the

corners and crevices of packing boxes used for shipping infested sweet-corn ears to market.

In badly infested fields, borers, nearly full grown, have been observed feeding upon the exterior of squash vines and turnips—plants which they are not known to enter. It is probable that the borers would feed upon almost any plant if forced to do so in order to survive.

In the laboratory the larger borers are able to eat their way through the cork stopper of an ordinary glass vial cage within a few days. A cotton plug, on the other hand, will resist their best efforts. The borers nibble and sometimes partially devour strips of paper placed in their cages. Escaped individuals will feed upon paper or pasteboard wrappers, and frequently bore their way through an ordinary pasteboard box and pupate inside.

These details concerning the peculiar activities of the borers are important because they emphasize the difficulty of combating an insect with such varied and adaptable feeding habits, and possessing such an ability to survive under adverse conditions.

NATURAL ENEMIES.

The natural enemies of the European corn borer in Massachusetts are very few and can not be relied on to hold the pest in check. Foreign writers also record the fact that in Europe and Asia the insect is not attacked to any extent by natural enemies.

INSECT PARASITES.

In Massachusetts a very small percentage of the larvæ, or borers, are destroyed by the young, or maggots, of four different kinds of two-winged parasitic flies.[1] These flies are of about the same size and appearance as house flies. Their maggots feed upon the internal juices and vital organs of the borer and finally cause its death. Just before the death of the borer the parasite maggot, being full grown, crawls forth from its host and forms a tough, leathery case, within which it passes into the next or pupal stage. This case, called the puparium, is located within the tunnel of the borer. In a few days the adult, or fly, emerges from this puparium and crawls along the tunnel, finally reaching the surface through the entrance hole of the host, or possibly through the exit hole made by its host preparatory to pupation. The fly then remains quiet until its wings are fully developed, whereupon it takes flight and searches for other borers to parasitize. During the season of 1918 only about 20 of these parasitic flies were reared from the European corn borer, and they have not thus far played a very important part in reducing the numbers of the pest.

[1] *Masicera myoidea* Desv., *Exorista pystc* Walk., *Exorista nigripalpis* Towns,. and *Phorocera erecta* Coq.

Two different kinds of four-winged wasp-like parasites[1] destroy a small number of the borers. The maggots of these parasites feed within the body of the borer and complete their growth after the borer has reached the pupa or resting stage, thus preventing the development of the moth. The parasite pupates within the pupa of its host and emerges therefrom as an adult in the tunnel of the borer, finally making its way to the surface to renew its activities. Only about a half-dozen of these parasites have thus far been reared from the European corn borer.

NATIVE BIRDS.

A few of our native birds, including blackbirds, woodpeckers, and crows, have been observed feeding on the larvæ of the European corn borer in Massachusetts. Since the insect is well protected within the plant during most of its life, however, birds can not be expected to cause much reduction in the numbers of the pest.

MEANS FOR PREVENTING WIDESPREAD INJURY TO THE COUNTRY'S CORN CROP.

Although the female moths of the European corn borer are capable of flight and may extend gradually the present known limits of the pest by natural spread, the chief danger to the country's corn crop lies in the possibility that plant material infested by the insect may be transported throughout the country and start other sources of infestation.

In order to combat this danger, it will be necessary strictly to enforce all Federal and State quarantines prohibiting the transportation out of the infested area of all plants or plant products likely to be infested by the borers.

Subjects for possible quarantine, or that have already been quarantined, as sources of danger, are green sweet corn or roasting ears; corn on the cob; corn cobs; cornstalks, whether used for packing or bedding; celery; Swiss chard; beet tops; spinach; string beans; oat straw; dahlia, chrysanthemum, gladiolus, and geranium plants. Further investigations will probably show the necessity for adding to this list.

These quarantine measures are being supplemented by extensive and careful clean-up operations within the infested area, having for their object the destruction of all plant material likely to harbor the borers. This work is now being conducted cooperatively by Federal and State authorities, aided in some instances by town or city officials and property owners.

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[1] (*Pimpla*) *Epiurus pterophori* Ashm. and (*Ichneumon*) *Amblyteles brevicinctor* Say.

TRANSPORTATION OF CORN BORER FORBIDDEN BY LAW.

An act of Congress dated March 3, 1905, provides that any person or common carrier who shall knowingly transport any insect in a live state, which is known to be notoriously injurious to cultivated crops, shall be liable, for each offense, to a fine of $5,000 or imprisonment at hard labor for five years, or both, at the discretion of the court.

METHODS OF CONTROL AND ERADICATION.

A most effective method of destroying the European corn borer is to burn, in areas of known or suspected infestation, all of the previous year's cornstalks, corn stubble, crop remnants, and stalks of garden plants, weeds, and larger grasses that may contain the overwintering borers. This must be done during the late fall, winter, and early spring while the borers are within such material.

Infested plants may also be disposed of when practicable by feeding them to live stock or by burying them in a manure or compost heap.

It should be clearly understood that each and every plant likely to be infested must be destroyed. This includes the stubble and upper part of the roots. Occasional plants, or parts of plants, which may seem hardly worth the trouble to clean up, are likely to harbor enough borers to give rise, by the end of the season, to as many insects as were present before the clean-up operations began.

Any method of control, in order to be effective in permanently reducing the numbers of the pest, must destroy at least 98 per cent of the borers present.

BURNING INFESTED PLANTS.

Burning is undoubtedly the most effective and cheapest method at present known for the destruction of infested material, especially during the late fall, winter, and spring, when the vegetation is dead and dry. As previously stated, in order to be effective, all parts of the plant must be burned, including the stubble and upper part of the root. It may be found necessary to sprinkle the plants with oil or to use other fuel in order to secure the complete combustion of the material.

In cornfields where the fodder is not used for feed the plants may be pulled up by the roots, or plowed out, and then collected in piles and burned. When the stalks are cut for fodder the stubble should be plowed out, raked up in piles, and burned.

The same method may be adopted for the destruction of the crop remnants of infested garden plants, such as bean vines and pods, tomato vines, potato vines, beet tops, celery tops, spinach, and Swiss chard, as well as the stalks of dahlia, gladiolus, geranium, and chrysanthemum.

The burning of infested weeds and grasses presents a very difficult problem, as the great variety of these plants infested by the European corn borer makes it necessary to clean up practically every one of the waste areas in the territory where the insect is present. The weeds and grasses grow among and adjacent to cultivated crops and are commonly found along ditches, fences, roadsides, and stream borders, and in vacant lots, pastures, dooryards, orchard lands, public dumping grounds, and other uncultivated areas.

In areas of considerable size, or in those distant from buildings or other inflammable material, the infested plants, when numerous enough and sufficiently dry, may be destroyed by a running fire. In a great many instances, however, it is necessary to pull or dig out the infested plants and burn them in piles at a safe distance from buildings. Frequently, too, the infested plants are so few and scattered that they will not support a running fire. Under some circumstances it is practicable to mow the infested plants as close to the ground as possible and afterwards destroy the stubble which may contain the borers. When the plants are green the difficulties in burning them are vastly increased; for this reason burning usually is easier and more effective during the winter and spring than in the fall. It is hoped that future investigations will lead to the adoption or development of some method of burning, or some burning apparatus, that will be much more cheap and effective than any method now in use.

Under the most favorable circumstances the burning of infested plants will be attended with considerable labor and expense, but it must be borne in mind that the insect with which we are dealing seriously threatens the corn-growing industry of this country and that radical measures must be adopted for its control.

Foreign writers record the fact that the methods outlined above have proved very successful in combating the pest in Europe, especially in Hungary.

FEEDING TO LIVE STOCK.

Under some conditions infested plants, especially corn, may be destroyed by feeding to live stock, either directly from the field or as ensilage. From the economic standpoint this is the best possible means of destroying infested plants. When slightly infested the value of corn plants as fodder is not materially lessened by the presence of the borers; the feeding of badly infested corn, however, is not recommended because of possible injurious results to stock. In

some of the districts within the infested area it is a common practice for the owners of live stock, especially dairy cows, to collect fodder from the sweet-corn plantings of the market gardeners and from home gardens after the crop has been harvested. Considerable quantities of sweet-corn fodder are disposed of in this manner, in addition to other corn grown primarily for feed, and the practice should be encouraged except in instances where infested corn fodder is transported to points outside the infested area.

Ordinarily, live stock will clean up all corn fodder when it is fed green, but when fed dry it is desirable to run the fodder through a cutting machine, or preferably a shredder, in order to make certain that all parts of the plant will be eaten. The shredding of the fodder renders it more acceptable to live stock and greatly reduces the chances that any of the borers contained therein will survive. Many of the borers are killed during the cutting or shredding process. A set of shredding blades for attachment to an ordinary corn cutter may be purchased from implement concerns for a comparatively small sum, and this method of treating infested corn fodder is strongly recommended.

The conversion of fodder into ensilage, when effected by ordinary methods, leads to the destruction of all borers present in the fodder, either when the fodder is passing through the ensilage cutter or as a result of conditions existing in the silo.

BURYING IN MANURE OR COMPOST.

In the market gardens or greenhouse establishments and on farms it is sometimes possible to bury infested plants in manure or compost piles. It is a common practice to dump weeds, cornstalks or corn stubble, and other crop remnants on a manure or compost pile in the field and then cover this material with the next load added to the pile. Under these conditions the covered plants, including the contained borers, are soon decomposed, or rotted, by the heat and fermentation occurring within the pile. With a slight modification of existing farm practices this method may be used to dispose of all infested material not accounted for in other ways. It may also be applied in small home gardens where a supply of manure or compost is kept on hand, but care should be taken to supply sufficient manure to insure a thorough heating of the material.

When corn fodder is used for bedding, or when it is fed to live stock in barns or feed yards, the unused portion of the fodder becomes mixed with the manure. This manure is generally thrown into a pit or into a pile. With a little extra care all manure containing this infested fodder may be covered deeply with other manure or with soil, and the complete destruction of all the borers assured.

PLOWING UNDER NOT RECOMMENDED.

The practice of plowing under infested material is not recommended, because plowing, even when carefully done, will not cover the material deeply enough to prevent the borers from making their way to the surface. Then, too, it has been found almost impossible to turn under *all* of the infested plants by plowing, for even the best of workmen leave a few plants or parts of plants on the surface of the soil, and these harbor enough borers to replace, within a season, the insects present before operations were begun.

POSSIBLE PREVENTIVE MEASURES.

REGULATING TIME OF PLANTING.

Injury to the early crops of sweet corn may be prevented to a certain extent in eastern Massachusetts by regulating the time of planting. During the year 1918 it was found that very early corn, planted about April 1 in the districts near Boston, was severely injured by the European corn borer, whereas corn planted about 10 days later was injured to a lesser extent, and plantings made in late April or early May were nearly free from injury. The dates of these plantings necessarily will vary from year to year according to weather conditions.

This variation in the amount of injury sustained by corn planted at different times may be explained by the fact that very early planted corn reaches the tassel stage about the middle of June when the first-brood moths of the borer are depositing their eggs. The moths prefer to deposit eggs on corn bearing a tassel or just coming into the tassel stage; therefore this early corn becomes severely infested. If corn in this stage of development is not present, the moths deposit their eggs upon other plants bearing a green seed head, generally some of the weeds or grasses. Consequently, when the later planted corn reaches the tassel stage, about July 1, most of the moths have deposited their eggs and these later plantings escape serious injury.

This method of preventing injury can not be applied to crops of late sweet corn or to field corn, so far as is now known, but it is hoped that future investigations may develop some cultural practice of a similar character that may minimize the ravages of the borer.

ARSENICAL POISONS NOT EFFICIENT.

Experiments in applying arsenical poisons to the surface of corn plants to prevent injury by the European corn borer have shown that large numbers of the borers may be poisoned in this manner during their early stages. At this time they feed to a slight extent on the surface of the plants, especially on the leaf blades. It was found impossible, however, to protect the plants entirely in this manner, as

the numbers of borers not killed by the poison were sufficient to damage the stalks and ears severely. The cost of applying these poisons is prohibitive under field conditions, because several applications of the poison are necessary owing to the fact that corn grows very rapidly during the period when injury occurs. The use of arsenical poisons to prevent injury by the European corn borer, therefore, can not be recommended.

The EUROPEAN CORN BORER
is the caterpillar of a small moth.
The moths lay their eggs in flat masses on the under sides of the corn leaves.
Broken tassels with extrusions of sawdust-like material at the breaks are the plainest signs of an infested field.
The caterpillars hatch from these eggs and feed at first on the leaves, but soon bore into the tassels, the stalk, the leaf-ribs and the ears
They live in the stalks all winter and in spring change to reddish-brown pupæ which soon transform again to moths.
Holes in the stalk with sawdust-like débris extruded indicate where the borer is at work.
The borer enters the ears through the husks and also through the stem and cob.
The pest also attacks other garden plants, weeds, and larger grasses, and lives through the winter in the stalks of these plants as well as in corn.
Burn All Plants Containing Caterpillars.
Cornstalks, corn stubble, grasses, weeds, and stalks of garden plants should be thus destroyed throughout infested areas during fall, winter or early spring. No other effective method is known for combating this pest.
Stubble and scattered stalks—showing where the borer spends the winter in corn.